PART NO. TELONIC

WO NO. Model HD-1A

TITLE Model HD-1A

PROJECT

TYPE BOOK

CURRENT PRINT REVISION LTR.				

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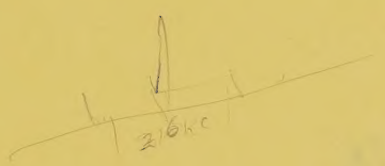
TI-13205-4

BOOK 1 OF 1


2.6kc

SPECIFICATIONS

MODEL HD-1A SWEEP GENERATOR

	LOW BAND	HIGH BAND
CENTER FREQUENCY	.5-400 MC	390-900 MC
FREQUENCY RANGE	.5-400 MC	360-910 MC
SWEEP WIDTH	200 KC-200 MC	.06-10%
OUTPUT		
Voltage	.75 volts peak to peak	1.5 volts peak to peak
Impedance	50 ohms	
Flatness	±5% over maximum sweep width	
ATTENUATION		
Turret	0, 10, 20, 30, 40, 50 db.	
Vernier	0 to over 10 db.	
DISPLAY LINEARITY	Normally below 1.2:1	
RADIATION	Less than 10 microvolts	
SWEEP RATE	Line Frequency (50-60 cps.)	
ZERO BASE LINE	Oscillator off during sweep retrace	
SCOPE HORIZONTAL SWEEP	Approximately 20 volts peak to peak	
SOURCE VSWR	Normally below 1.2:1	
POWER	115/230 Vac., 50/60 cps., Approximately 120 watts	

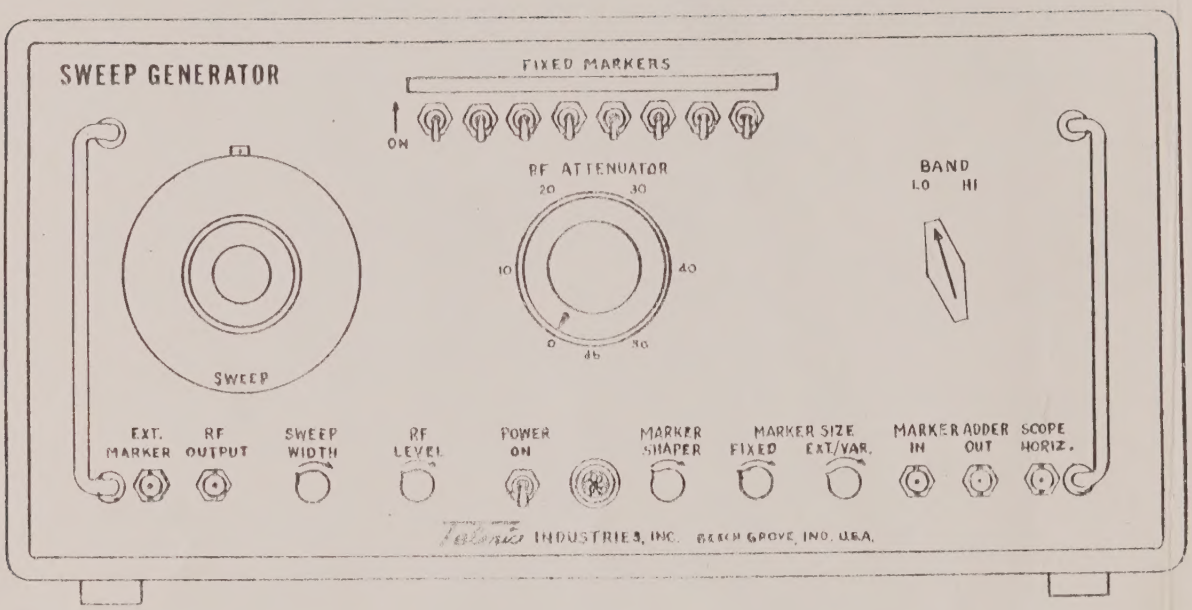
MARKER SYSTEM

Birdy-By-Pass Marker Circuitry — The output of the marker oscillators is mixed with a signal from the sweep oscillator to produce beatnotes or birdies. These are amplified and superimposed upon the detected RF output signal before it is applied to the vertical scope input. Amplitude and shape of the markers are adjustable over a wide range.

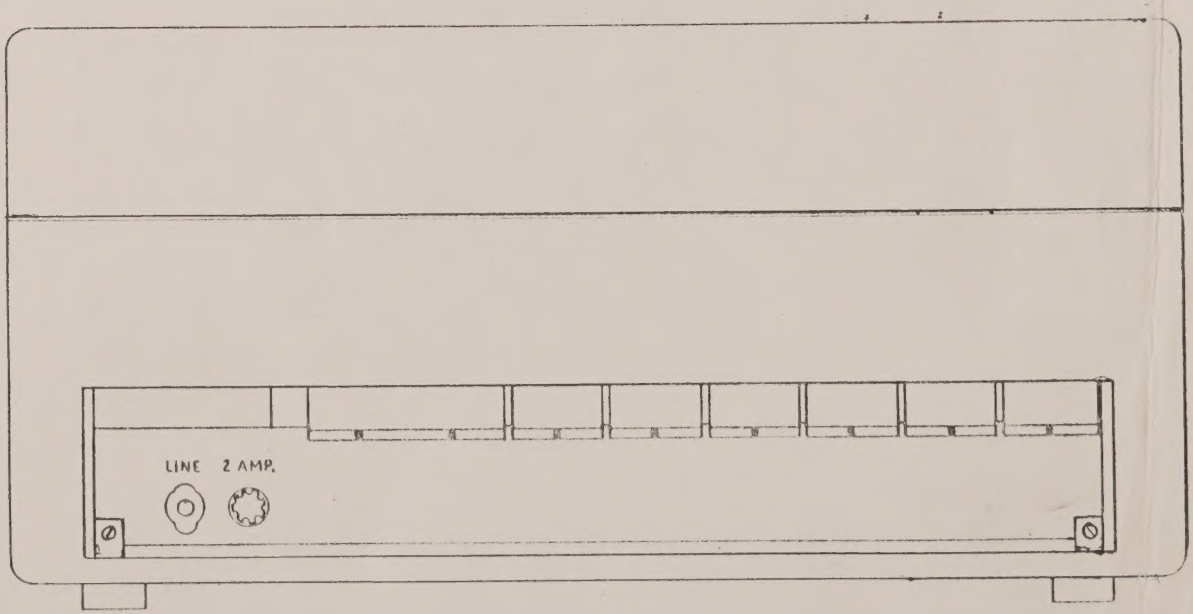
External Marker Input — An external CW signal of approximately 0.1 volts may be used to produce a "birdy" type marker.

Plug-In Crystal Markers — Provisions are included for up to eight single frequency or harmonic type plug-in crystal-controlled markers. These markers are optional and may be included in this instrument or added at a later date. See our literature for further details regarding these markers.

PHYSICAL DESCRIPTION — Panel Size - 1/8" x 8 3/4" x 19".
Chassis Size - 2" x 14 1/2" x 17".


SWEEP GENERATOR
FIXED MARKERS
ON
RF ATTENUATOR
20
30
10
40
0
db
50
BAND
LO
HI
SWEEP
EXT. MARKER
RF OUTPUT
SWEEP WIDTH
RF LEVEL
POWER ON
MARKER SHAPER
MARKER SIZE FIXED
EXT/VAR.
MARKER ADDER IN
OUT
SCOPE HORIZ.
INDUSTRIES, INC. BEACH GROVE, IND. U.S.A.

FRONT

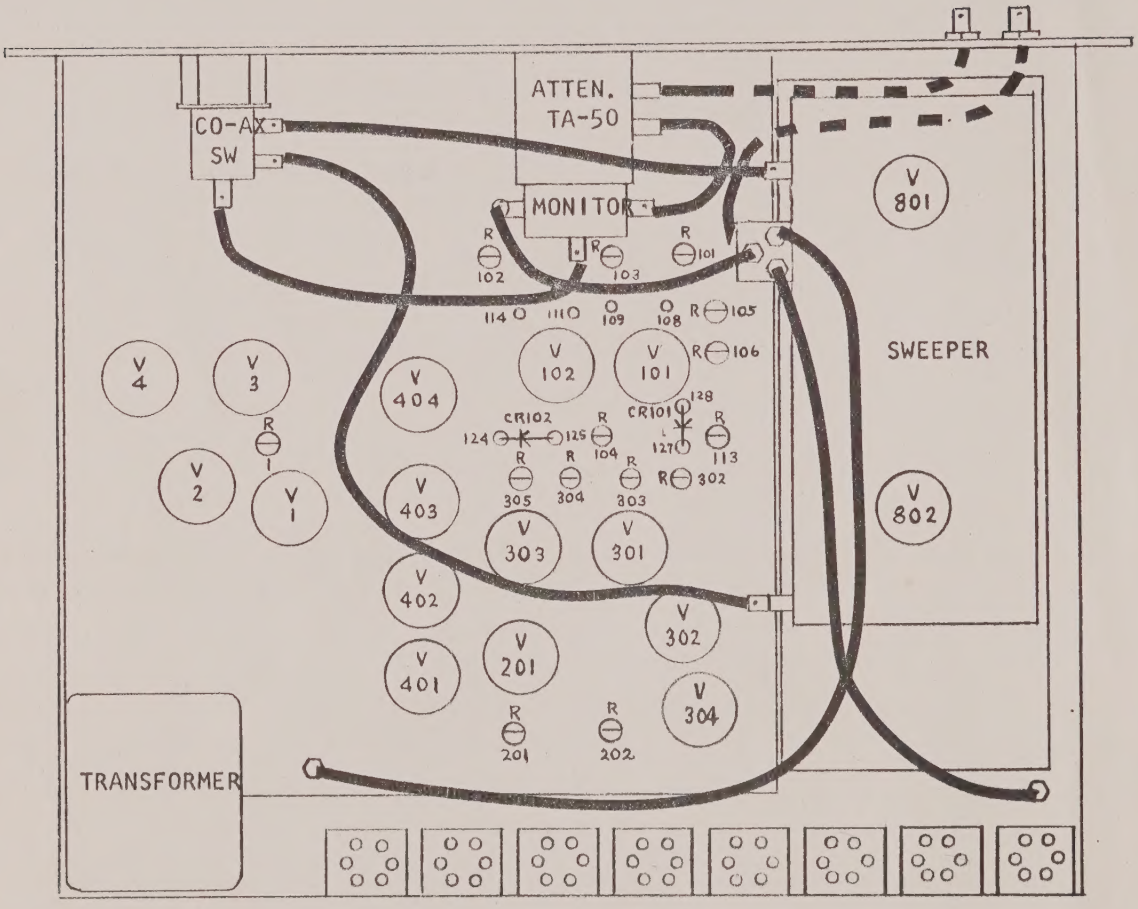

LINE 2 AMP.

REAR

DESCRIPTION OF FRONT PANEL

SWEEP DIAL	Indicates center frequency of the sweep oscillator. Calibrated at minimum sweep width.
RF ATTENUATOR	Turret Attenuator provides indicated amounts of attenuation.
BAND SWITCH LO-HI	Selects low or high band as indicated on the sweep dial.
FIXED MARKERS	These switches supply B+ to the fixed markers (crystal plug-in units) when in the on position.
EXTERNAL MARKER	Marker input for external signal source.
RF OUTPUT	RF sweep output - BNC Connector - Impedance 50 ohms.
SWEEP WIDTH	Varies the amount of voltage supplied to the vibrating capacitor and can be used to vary the sweep width.
RF LEVEL	Determines the average B+ supplied to the sweep oscillator and may be used as a vernier level control.
POWER ON	Switches AC power on and off.
MARKER SHAPER	Varies the width of the marker signals.
MARKER SIZE	
Fixed	Varies the amplitude of the fixed markers (crystal plug-in units).
Ext/Var	Varies the amplitude of the external marker signals.
MARKER ADDER	
In	The demodulated signal from the device being tested is fed into this connector so that marker signals may be superimposed.
Out	This connector should be connected to the vertical input terminals of the scope for viewing the demodulated signal and markers.
SCOPE HORIZONTAL	This connector should be connected to the scope horizontal amplifier input.

CHASSIS LAYOUT



V1	5651
V2	6AU6
V3	EL84/6BQ5
V4	EL84/6BQ5
V101	12AX7
V102	12AX7
V201	12AX7
V301	6AU6
V302	12AX7
V303	6AU6
V304	EL84/6BQ5
V401	12AX7
V402	12AX7
V403	12AX7
V404	12AX7
V801	6AF4-A
V802	6AF4-A

DESCRIPTION OF CHASSIS CONTROLS

R1 - B+ ADJUST — This control varies the bias on the amplifier, (V2), for the B+ regulator, (V3), and is adjusted to produce a regulated B+ voltage (B+2) of 175 volts.

R201 - BLANKING PHASE — This control adjusts the phase of the blanking pulse with reference to the phase of the sweep oscillator.

R202 - BLANKING WIDTH — This control is the grid resistor for the blanking pulse generator (V201). It is adjusted to blank one-half of the sweep cycle to produce a zero base line.

HIGH BAND ADJUSTMENT

R102 - SWEEP WIDTH LIMIT — This potentiometer controls a voltage supplied to the front panel SWEEP WIDTH control and is used to adjust the sweep width when the front control is set at maximum.

R104 - HORIZONTAL SIZE — This control adjusts the size of the horizontal output when the front panel SWEEP WIDTH control is set to its maximum position. It is adjusted to maintain a constant horizontal size at all sweep width settings.

R105 - HORIZONTAL PHASE — This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.

R113 - LINEARITY — This control can be used to change the waveform of scope horizontal output (V101). It is normally set for best linearity at maximum sweep width.

R303 - LEVEL MINIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its minimum position.

R305 - LEVEL MAXIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.

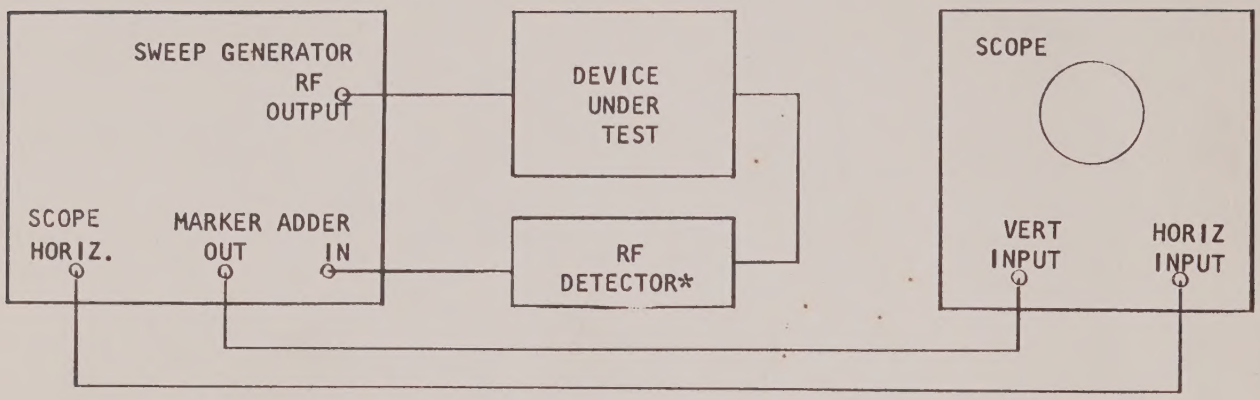
LOW BAND ADJUSTMENT

R101, R103 - SWEEP WIDTH ADJUSTMENT — These two potentiometers limit the voltage supplied to the dual front panel SWEEP WIDTH control and are used to adjust the sweep width when the FRONT PANEL control is set at maximum. R101 controls the sweep width on the low frequency side of the display and R103 the high frequency side.

R106 - HORIZONTAL PHASE — This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.

R302 - LEVEL MINIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its minimum position.

R304 - LEVEL MAXIMUM — This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.



TYPICAL SET UP - The following procedure is recommended for setting up this instrument in test position.

1. Connect unit to proper power line voltage and turn POWER ON switch to ON position.

2. Make connections to the scope, the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different from the impedance of the sweep generator, a matching network should be used to insure a constant input signal.

3. Adjust the RF output level by means of the RF LEVEL control and the step RF ATTENUATOR to the proper input signal for the device being tested. Failure to do this will result in a misleading scope pattern.

4. Adjust the SWEEP WIDTH control and center frequency SWEEP DIAL to cover the desired frequency range.

5. MARKERS
   Markers may be produced by one or more of the following methods.
   A. Plug-in crystal markers (C type).
   B. Plug-in crystal harmonic markers (CDH or CH type).
   C. External C.W. Signal.
   First turn on marker unit or inject external C.W. signal and adjust MARKER SIZE and SHAPER until markers are of a convenient size and width.

*See Telonic literature for detector recommended for use with this instrument.

INTERNAL CONTROL ADJUSTMENT

PRINTED WIRING BOARD CONTROLS are adjusted at the factory and normally do not require any readjustment. However, should it be desirable to check adjustments, follow these steps:

1-Connect unit as shown under operating instructions but omit the device under test. The recommended detector for the unit is the Telonic XD-3. Turn unit on.

2-B+2 ADJUSTMENT: Adjust R1 to provide a regulated B+ voltage of 175 volts.

THE FOLLOWING ADJUSTMENTS ARE MADE WITH THE BAND SWITCH IN THE HI BAND POSITION

3-BLANKING PHASE and WIDTH ADJUSTMENTS: Set front panel SWEEP WIDTH control to its maximum counter-clockwise position, front panel RF OUTPUT LEVEL control to its maximum clockwise position and the ATTENUATOR to its 0 db. position. A rectangular pattern should appear on the scope. If not, adjust BLANKING PHASE and WIDTH controls, R201 and R202.

Equal to Peak RF Output Approx.

1.8V. Approx.

BLANKING PHASE

Misadjusted

BLANKING WIDTH

Misadjusted

BLANKING PHASE & WIDTH

Misadjusted

4-RF OUTPUT LEVEL MIN and MAX ADJUSTMENTS: With the front panel RF LEVEL control in its maximum clockwise position, adjust LEVEL MAXIMUM control, R305, until vertical height of the pattern equals $\frac{1}{2}$ of the peak to peak RF output voltage shown on the specification sheet, Page 1. Since the RF Detector is approximately 90% efficient, the actual RF output voltage will be slightly higher than the voltage shown on the scope. Turn turret attenuator to 10 db. position and record the height of the pattern. Return the turret attenuator to the 0 db. position. Turn the front panel RF LEVEL control to its maximum counter-clockwise position and adjust LEVEL MINIMUM control, R303, until the height of the pattern is slightly less than it was with 10 db. inserted in the output circuit. This procedure insures that the RF LEVEL control will provide over 10 db. of vernier attenuation.

5-HORIZONTAL PHASE and SIZE ADJUSTMENTS: Return front panel RF LEVEL control to maximum clockwise position. Set SWEEP WIDTH control to its maximum clockwise position. If pattern is not rectangular, adjust HORIZONTAL PHASE, R105, until a rectangular pattern is obtained. If Horizontal Size has increased or decreased, adjust HORIZONTAL SIZE, R104, until pattern has the same horizontal size as it had with the SWEEP WIDTH control in its counter clockwise position.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

6-SWEEP WIDTH ADJUSTMENT: With the front panel SWEEP WIDTH control in its maximum clockwise position, adjust the SWEEP WIDTH LIMIT, R102, to provide the maximum sweep width as shown on the specification sheet, Page 1. 10%

7-LINEARITY ADJUSTMENT: Linearity may best be adjusted when a number of markers are present on the display. In the factory, a harmonic generator is used for this purpose. The LINEARITY control, R113, is adjusted for equal spacing between the

markers. Adjusting the LINEARITY control will change the size of the scope horizontal signal, therefore, the HORIZONTAL SIZE must be readjusted, see step 5. The HORIZONTAL PHASE control also has an effect on linearity and can be adjusted slightly to obtain optimum linearity. Generally it is adjusted to spread the markers at the low frequency side of the display as much as possible and still maintain a rectangular pattern. If a harmonic generator is not available, a variable marker may be used. The linearity adjustment is made so that there is an equal spacing from the center of the presentation to each side.

THE FOLLOWING ADJUSTMENTS ARE MADE WITH THE BAND SWITCH IN THE LOW BAND POSITION

8-RF OUTPUT LEVEL MIN. and MAX. ADJUSTMENTS: Adjustment procedure is the same as the hi band adjustments outlined in step 4, substituting R304 for R305 (MAX. ADJUSTMENT) and R302 for R303 (MIN. ADJUSTMENT). R304 must not be adjusted for more than rated output since this will cause an unleveled RF output signal.

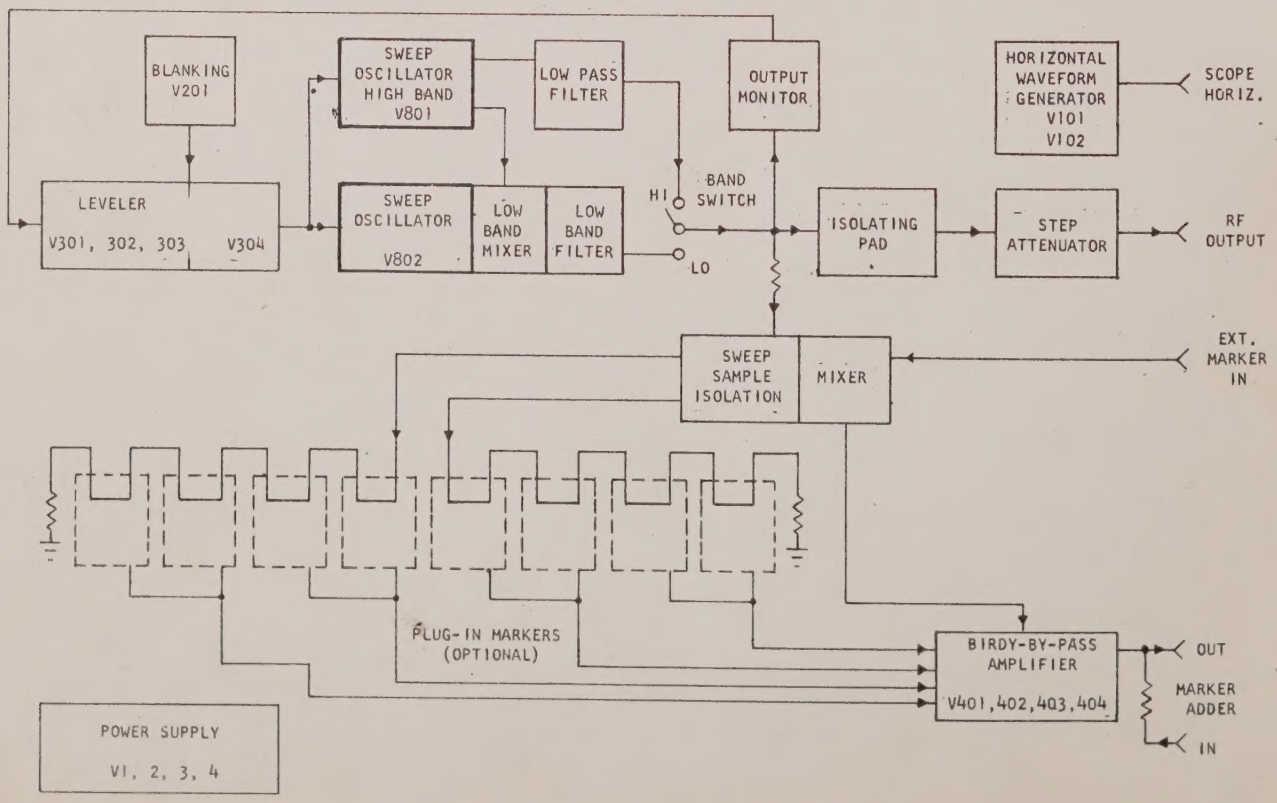
9-HORIZONTAL PHASE ADJUSTMENT: Set SWEEP WIDTH control to its maximum clockwise position. If pattern is not rectangular, adjust HORIZONTAL PHASE, R106, until a rectangular pattern is obtained.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

10-SWEEP WIDTH ADJUSTMENT: With the front panel SWEEP WIDTH control set for maximum sweep width and the SWEEP DIAL set for a frequency of 300 MC, adjust R101 until the lowest frequency obtained on the display is 200 MC. R103 is next adjusted until the highest frequency obtained on the display is 400 MC.

11-LINEARITY: There are no linearity controls for the low band. Linearity is obtained by the proper adjustment of the SWEEP WIDTH controls, R101 and R103, and by the HORIZONTAL PHASE control, R106.

BLOCK DIAGRAM



SWEEP OSCILLATOR

HI BAND: The sweep oscillator of this unit is a fundamental frequency type, using a 6AF4 tube and tuned line circuitry. A vibrating capacitor, consisting of a silver plated beryllium copper diaphragm is used to obtain the sweep. A high pass filter is included in the output circuitry to minimize harmonics in the R.F. output and to insure optimum performance of the leveling circuitry.

LOW BAND: The low band output is produced by the heterodyne method which combines the output of the Hi Band Sweep Oscillator with a second fixed tuned sweep oscillator. These two sweep oscillators are swept 180° out of phase which accounts for the wide sweep width since the sweep width of each sweep oscillator is added in the heterodyne output. This method of sweeping also produces excellent linearity since the nonlinearities of each sweep oscillator are canceled in the heterodyne output.

Four diodes in a bridge circuit produce the mixing of the two fundamental frequencies and due to the balanced nature of this mixer, a high output is produced with a minimum of harmonic or spurious content. A low pass filter removes the fundamental frequencies and allows the output or heterodyne frequencies to pass out through the monitor and attenuator to the final output. The oscillator circuits are similar and have similar frequency versus voltage or frequency versus temperature effects to minimize drifts.

BLANKING CIRCUIT

The purpose of the blanking circuit is to produce a zero base line by removing B+ from the Sweep Oscillator during the sweep retrace. The blanking voltage is originated by a square wave producing circuit. A phased 6.3 volt sinewave is squared and amplified by the blanking tube. This square wave output of V201 controls V304 (EL84), the sweep oscillator voltage regulator tube, and thus deprives the Sweep Oscillator of voltage during one-half of each cycle. PHASE and WIDTH controls are provided for adjusting this blanking voltage to coincide with the horizontal and sweep drive signals.

AUTOMATIC OUTPUT LEVELING CIRCUITRY

A sample of the sweep oscillator output is detected by the monitor diode, located in the monitor block. This detected signal is then amplified and used to control the plate voltage of the sweep oscillator. The RF LEVEL control adjusts the bias on the first stage of the amplifier. This causes the DC levels in the entire amplifier to change, and varies the average B+ supplied to the sweep oscillator from a minimum of 25V to over 100V. A small decrease in the sampling voltage causes a large increase in the B+ supplied to the sweep oscillator, and thus counteracts any amplitude variation as the oscillator is tuned over the range.

The operation of this circuit and of the sweep oscillator can be checked at Pin 1 of V301. The waveform at this point will normally show a flat output level over the entire band. Adjusting the RF LEVEL control will change this level.

To replace the monitor diode, remove the insulated holding screw in the monitor block and then remove diode from the block.

HORIZONTAL SWEEP OUTPUT CIRCUITRY

HI BAND: In order to maintain good linearity, it is necessary to change the shape of the Horizontal Sweep signal for different settings of the SWEEP WIDTH control. This is necessary because of the non-linear characteristics of the vibrating sweep

capacitor. At high sweep width settings a non-linear sawtooth waveform is required for good display linearity. This waveform is produced by V101. A phased 6.3 volt sinewave is applied to the grid of V101A. The tube then clips and amplifies the grid signal so that a square wave is produced at the plate. This square wave is then shaped by a RC network in the plate circuit consisting of R113 and C104 to produce a non-linear sawtooth waveform. R113 (LINEARITY control) is a variable resistor and permits the shape of the waveform to be adjusted. This non-linear sawtooth voltage is then applied to V101B which is connected as a cathode follower. The output of the cathode follower is then applied to the Scope Horizontal Amplifier and compensates for the non-linear characteristics of the vibrating sweep capacitor at high sweep widths. At sweep widths from minimum to approximately 50%, the vibrating sweep capacitor is quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a non-linear sawtooth waveform at high sweep width settings.

LOW BAND: In order to maintain good display linearity at high sweep width settings, a linear sawtooth waveform is required. This linear sawtooth voltage is produced by V102. A square wave from the plate of V101A is applied to the grid of V102A. The tube then clips and amplifies the grid signal so that a square wave of opposite polarity appears at the plate. This square wave is then shaped by a RC network in the plate circuit consisting of R120 and C108 to produce a linear sawtooth waveform. This linear sawtooth waveform is then applied to V102B which is connected as a cathode follower. The output of the cathode follower is then applied to the Scope Horizontal Amplifier and compensates for the non-linear characteristics of the vibrating sweep capacitors at high sweep width settings. At sweep widths from minimum to approximately 50%, the vibrating sweep capacitors are quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a linear sawtooth waveform at high sweep width settings.

POWER SUPPLY

The power transformer output of 140 volts AC is fed into a half wave voltage doubler, using silicon rectifying elements CR1 and CR2. B+ is taken off the capacity input filter to provide +375 volts unregulated to the plates of V3, (B+ regulator pass tube), V304 (oscillator pass tube), and V4 (marker B+ pass tube).

B+2 is the output of the electronic regulator circuit, consisting of V2 and V3, and provides +175 volts regulated. Potentiometer R1 controls the operating point of V2, regulator amplifier, and is set for proper B+2 output voltage.

B+3 is obtained by biasing the grid of V4 at approximately 85 volts positive, which causes current to flow through cathode resistor R20. The voltage at Pin 3, V4, is supplied to the Plug-In Markers and maintains its regulation due to the low impedance characteristics of the cathode follower circuit and provides approximately 100 volts.

The B- voltage is obtained by the half wave Silicon rectifier CR3. Regulator tube V1 maintains this voltage at -82 volts, and supplies bias voltage to the leveler circuit as well as a reference voltage for the electronic regulator.

Resistor R4 acts as a fuse, protecting the transformer and rectifiers from overload.

The primary of the power transformer is normally wired for 115 volt AC line operation. However, it can be converted to operate from a 230 volt AC source if desired. This conversion is described in the maintenance section.

MARKER SYSTEM DESCRIPTION

GENERAL

A sample of the sweep signal is mixed with the fundamental or a harmonic of the crystal plug-in marker units or external signal to produce beatnotes or birdies. These birdies are then amplified and superimposed upon the demodulated swept signal and applied to the vertical amplifier of the oscilloscope. The size and shape of the marker may be varied over a wide range by the SIZE and SHAPER Control of the birdy amplifier.

EXTERNAL MARKER INPUT

The CW signal from the external marker input is fed into a diode mixer, where it is mixed with a sample of the sweep signal to produce birdies. The resultant birdy is then fed into the birdy-by-pass amplifier.

PLUG-IN MARKERS

This unit has provisions for a maximum of eight single frequency (C Type) crystal markers, eight harmonic (CH type) crystal markers, or four harmonic (CDH type), or any combination. Each CDH type marker occupies the space of two C or CH type.

Two sweep sample outputs are available from the sweep oscillator, in order to minimize coupling between marker signals. For optimum operation harmonic and single frequency markers should not be fed from the sweep sample line.

SINGLE FREQUENCY MARKERS (C TYPE)

These crystal markers are self-contained plug-in units. Additional units at other frequencies (within the range of the sweep generator) may be ordered and substituted for the original units.

The crystal oscillator units include the tube, crystal oscillator tuning, crystal diode mixer, and a tuned circuit selecting the sweep input frequency. A test point is provided for easy adjustment of the overtone crystal oscillator (this circuit used above 12 mc.). In making this adjustment, the crystal oscillator coil slug is adjusted for near maximum voltage at the test point. This is usually in the order of 2-5 volts as measured with a VTVM. The adjustment should be made just slightly off the peak on the low inductance side, since the effects of tuning are critical on the other side of the resonance curve. Crystal oscillators below 12 mc. are Pierce type oscillator circuits which require no tuning.

By tuning the sweep sample coil, the frequency of the sweep input signal can be varied and thus minimize unwanted markers generated from other harmonics of the crystal oscillator. The amplitude can be varied by adjusting the coupling.

HARMONIC MARKERS

Harmonics of a crystal-controlled oscillator are mixed with a portion of the sweep signal to produce a display of markers at regular intervals across the sweep range.

CH TYPE - This type utilizes a single tube and produces harmonic markers over a limited range.

CDH TYPE - This type uses two tubes and therefore will produce harmonics over a much larger range than the CH type. For example, the CH type, 1 mc., harmonic generator will produce harmonic markers to approximately 25 mc. where the CDH type, 1 mc., harmonic generator will produce markers to over 300 mc.
(See our literature on plug-in markers for additional information).

MAINTENANCE

POWER SUPPLY: Since a defect in the power supply will affect all circuits, it should be checked for proper operation before proceeding to other circuits.

SUPPLY	NOMINAL VALUE	NORMAL VARIATION	NORMAL RIPPLE	WIRE COLOR*
AC Line	115V	---------	------	------
B+1	375	±15 Volts	6 to 15 volts	Red
B+2	175	±.5 Volts	12 to 25 millivolts	Blue
B+3	100	±5-10 Volts	15 millivolts to .5 volts	Orange
B-	-82	±2 Volts	100 millivolts	White
6.3 "A"	6.3V AC	Main filament supply		Green
6.3 "B"	6.3V AC	180° out of phase with supply "A". Source of phasing and filament voltages.		Gray
6.3 "C"	6.3V AC	Isolated filament voltage for tubes with cathodes above ground.		Brown

NEXT: If power supply is operating normal, use the block diagram to isolate the trouble to a major section. Check tubes, diodes, and adjustment of Front Panel and printed wiring board controls located within that section (see Page 7 for adjustment procedure). By the use of the schematic, ordinary difficulties encountered can be readily located and remedied. The following trouble-shooting chart is an additional aid to servicing:

SYMPTOM	POSSIBLE CAUSE AND REMEDIES
Pilot Light OFF and unit Fails to Operate	Fuse open - replace. If second fuse opens - look for cause of overload, shorted wiring, components, etc.
B+1 Off Value or Excessivle Ripple	Check R4, C1, C2, CR1, and CR2.
B+2 Off Value or Excessive Ripple	Check R1 for proper adjustment. Check R15, it will burn out if B+2 is overloaded. Check V1, V2, V3, tubes and circuitry.
B+3 Off Value or Excessive Ripple	Check R17 and R21 (these resistors adjust the voltage on the grid of V4, a cathode follower, which in turn determines the voltage on the cathode). Check R18 (this resistor will burn out if B+3 is overloaded). Check V4 and C2.
B- Off Value or Excessive Ripple	Check C3, C4, C5, CR3, R3, R5 and R6. Check V1 to see if it is lit properly (should be a steady orange glow).

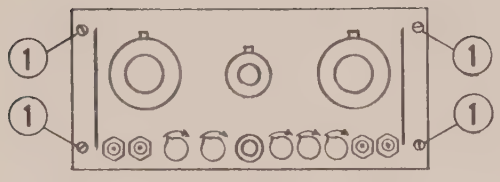
*Wire colors do not apply to shielded wires - single wires only.

V1 Not Lit Properly	If replacing V1 and checking the above parts does not remedy the trouble, check the line voltage. Low line voltage could cause this trouble. Reducing the value of R3 slightly will usually eliminate this difficulty.
RF Output is Low or Zero	Check R314 - this resistor will burn out if the B+ to the sweep oscillator is overloaded. Check B+ to the sweep oscillator, cathode of V304. It should be a positive square wave of 25-100 volts and should vary as the OUTPUT LEVEL control varies. If it is normal, look for RF difficulties, defective tube, components, shorted or open wiring, etc. Replace mixer diodes in sweeper box, observe polarity. If the voltage is low and does not respond to the LEVEL control, remove first V303 and then V201. When either of these tubes conducts, the voltage on the grid of V304 (pin 2) is reduced and thus decreases the B+ to the sweep oscillator. If removal of V201 allows the the B+ on V304 (pin 3) to return to normal, check the blanking tube, controls, and associated circuitry. If removal of V303 causes the B+ to return to normal, check the LEVELER controls, V301 and V302, tubes, and associated circuitry.
Poor Leveling	Replace monitor diode. Also replace V301, V302, and V303. V301 is the most critical since it is in the first stage of the DC coupled amplifier. Resetting the printed circuit LEVEL controls is sometimes necessary if these tubes are replaced.
Weak Markers	Replace IN82 or IN34 crystal diode mixer. Check Birdy-By-Pass Amplifier, tubes and circuitry.
No Horizontal Output	Look for difficulty in the sawtooth circuitry V101, using the printed circuit board layout and schematic to check waveforms and voltages.

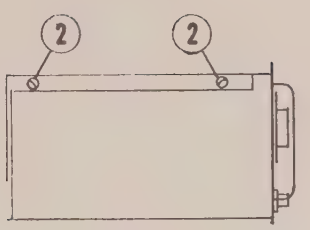
CONVERSION FOR 230 VOLT POWER LINES

The dual primary of the power transformer is normally wired in parallel for use on 115 volt AC lines. If desired, the windings can easily be reconnected in series for use with 230 volt power. With the aid of the Chassis Layout, bottom view, locate terminals 1, 2, 3, and 4. Remove the jumper wires between terminals 1 and 2 and between terminals 3 and 4. Then install a jumper wire between terminals 2 and 3.

RACK MOUNTED UNIT



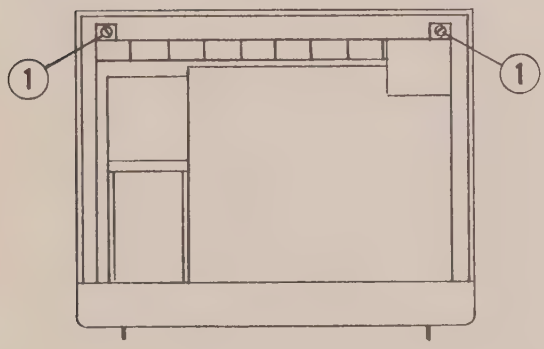
FRONT



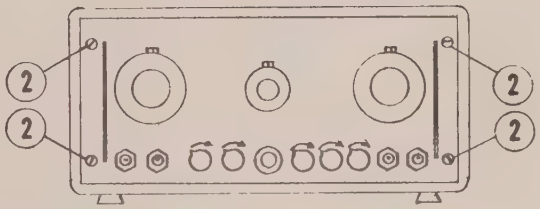
SIDE

Unit has front panel slotted or drilled for standard RTMA Mounting. Position unit in rack and install mounting screws in holes marked (1).
Dust cover removal: Remove four #8-32 thread-cutting screws, marked (2) (two on each side) and lift off cover for easy access to chassis.

CABINET MOUNTED UNIT



TOP



FRONT

To remove chassis from cabinet; first remove the two #8-32 screws (marked (1) on top view above) at the back of the chassis (one on each side). These screws fasten the chassis to the cabinet guide rails. Second, remove the four #10-32 screws (marked (2) in front view above). The screws hold the panel to the cabinet.

Slide chassis out of cabinet by pulling forward on the two front panel handles.

To replace chassis in cabinet, insert the flanges on the bottom of the chassis side panels into the slot of the cabinet guide rails. Push chassis back into cabinet far enough for the slots in the side panel flanges to align with the retained nut in guide rail. Install the two #8-32 screws and tighten securely. Replace the four #10-32 screws in the front panel.

PART VALUE INFORMATION

SCHEMATIC PART DESIGNATION

C	Capacitor
CR	Crystal Rectifier, Germanium Diode
F	Fuse
I	Incandescant Pilot Light
J	Jack or termination, Coaxial Connector
K	Cable
L	Coil
M	Meter or Motor
P	Plug, Coaxial Connector
R	Resistor, Fixed or Variable
S	Switch
T	Transformer
V	Tube
Z	Miscellaneous

SCHEMATIC VALUE ABBREVIATION

Ω	ohms
KΩ	1,000 ohms
MΩ	1,000,000 ohms (megohms)
μf, uf	Microfarad
μμf, uuf	Micromicrofarad
μh, uh	Microhenry
mh	Millihenry

RESISTORS - All resistors are $\frac{1}{2}$ watt $\pm$ 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are $\pm$ 2%.

CAPACITORS - All capacitors are shown in micromicrofarads (uuf) unless otherwise specified.

COILS - All coils are shown in microhenries (uh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
P.C.B. Printed Circuit Board
R.P. Rear Panel
C.H. Chassis
T.P. Test Point

PARTS NUMBERS - LOCATION INFORMATION

1 - 99 - Power Supply
101 - 199 - Horizontal and Alternate Sweep Drive Circuit.
201 - 299 - Blanking
301 - 399 - Leveler
401 - 499 - Birdy-By-Pass
501 - 599 - Mixer & Plug-In Markers
601 - 699 - Variable Markers
701 - 799 - Attenuators
801 - 899 - Sweep Oscillator and Sweep Drive Circuit
901 - 999 Modifications and Special Circuits

*Indicates value of component adjusted at factory, and may deviate from value shown on print.

—○— Indicates printed circuit board terminal.

N O T I C E

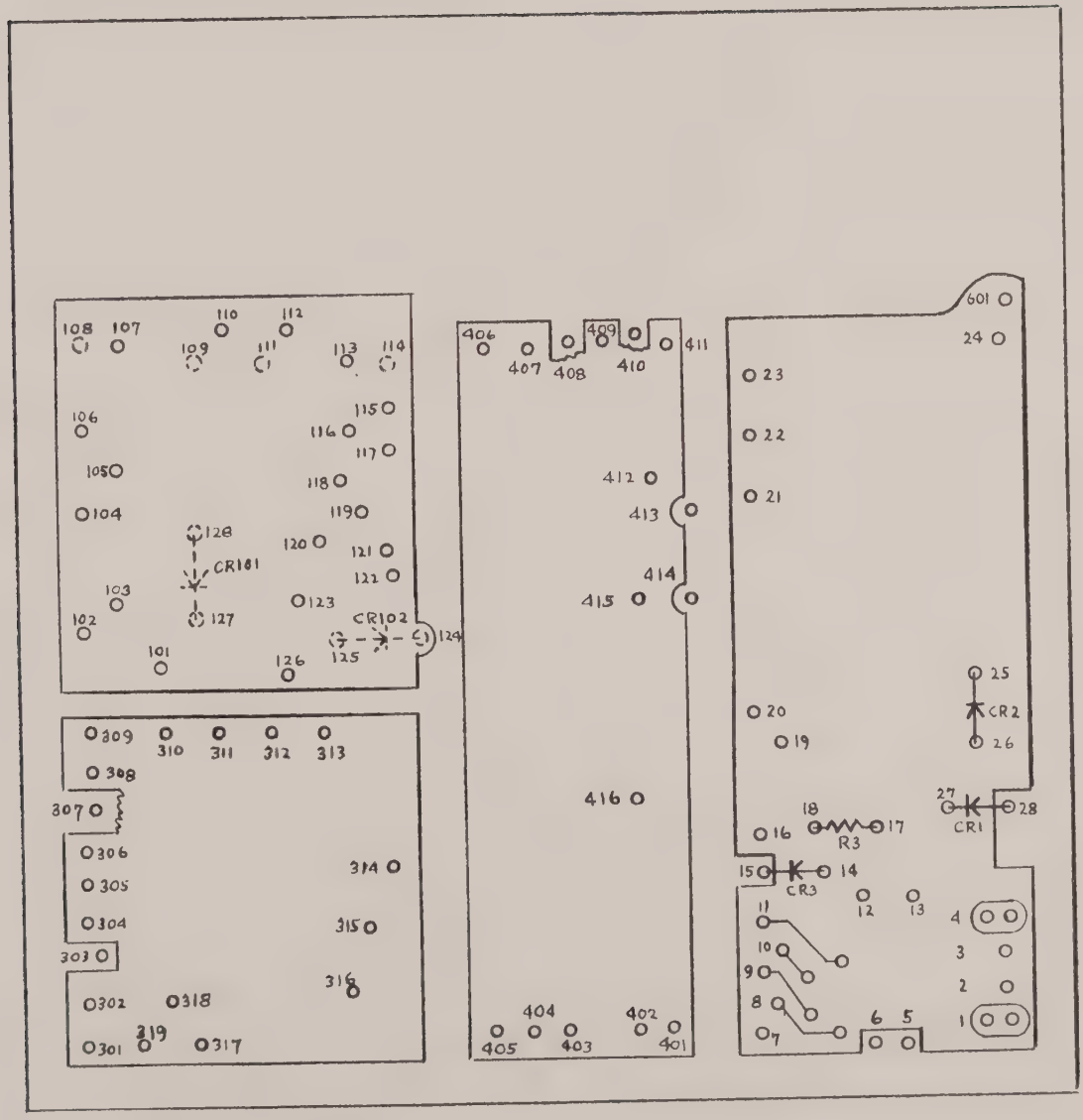
RED LACQUER IS USED TO INDICATE FASTENINGS THAT SHOULD NOT BE DISTURBED FOR ORDINARY SERVICE, AND TO SECURE ADJUSTABLE CONTROLS.

CHASSIS LAYOUT

BOTTOM VIEW

TERMINALS

FRONT



PARTS LIST

CIRCUIT REF.	DESCRIPTION	PART NO.
	CAPACITORS	
C1	Fixed, electrolytic, 80 μf., 250 VDCW	C-314
C2A	Fixed, electrolytic, 80 μf., 450 VDCW	C-308
C2B	Fixed, electrolytic, 20 μf., 250 VDCW	C-308
C3	Fixed, electrolytic, 30 μf., 250 VDCW	C-313
C4	Fixed, electrolytic, 30 μf., 250 VDCW	C-313
C5	Fixed, electrolytic, 30 μf., 250 VDCW	C-313
C6	Fixed, paper dielectric, .22 μf., ±20%, 200 VDCW	C-215
C7	Fixed, paper dielectric, .22 μf., ±20%, 400 VDCW	C-217
C8 thru C100	These circuit references not assigned.	
C101	Fixed, paper dielectric, .1 μf., ±20%, 200 VDCW	C-203
C102	Fixed, paper dielectric, .1 μf., ±20%, 200 VDCW	C-203
C103	Fixed, dura-mica, .0033 μf., ±10%, 600 VDCW	C-52
C104	Fixed, dura-mica, .0022 μf., ±10%, 600 VDCW	C-24
C105	Fixed, paper dielectric, .47 μf., ±20%, 200 VDCW	C-216
C106,C107	These circuit references not assigned.	
C108	Fixed, paper dielectric, .01 μf., ±20%, 600 VDCW	C-210
C109	Fixed, paper dielectric, .1 μf., ±20%, 200 VDCW	C-203
C110	Fixed, paper dielectric, .1 μf., ±20%, 200 VDCW	C-203
C111 thru C200	These circuit references not assigned.	

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	CAPACITORS CONT.	
C201	Fixed, paper dielectric, .1 μf., ±20%, 200 VDCW	C-203
C202	Fixed, paper dielectric, .22 μf., ±20%, 200 VDCW	C-215
C203 thru C300	These circuit references not assigned.	
C301	Fixed, ceramic disc., .01 uf., GMV, 600 VDCW	C-20
C302	Fixed, ceramic disc., 50 μμf., ±10%, NPO, 1000 VDCW	C-11
C303	Fixed, ceramic disc., 33 μμf., ±10%, NPO, 1000 VDCW (this part subject to change)	C-10
C304	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C305 thru C400	These circuit references not assigned.	
C401	Fixed, ceramic disc., 120 μμf., ±10%, 600 VDCW, N750	C-14
C402	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C403	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C404	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C405	Fixed, ceramic disc., 1000 μμf., GMV, 600 VDCW	C-19
C406	Fixed, ceramic disc., 1000 μμf., GMV, 600 VDCW	C-19
C407	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C408	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C409	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C410	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C411	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
C412 thru C500	These circuit references not assigned.	
C501	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C502 thru C800	These circuit references not assigned.	
C801	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	CAPACITORS CONT.	
C802	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C803	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C804	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C805	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C806	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C807	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C808	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C809	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C810	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C811	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C812	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C813	Fixed, ceramic feedthru, 1000 μμf., GMV, 500 VDCW	C-39
C814	Fixed, solder-in, ceramic disc., 4 μμf., ±5%, NPO, 500 VDCW	C-41
C815	Fixed, solder-in, ceramic disc., 4 μμf., ±5%, NPO, 500 VDCW	C-41
C816	Fixed, composition, .5 μμf., ±10%, 500 VDCW	C-29
C817	Fixed, electrolytic, 100 μf., 10 VDCW	C-317
C818	Fixed, electrolytic, 100 μf., 10 VDCW	C-317
C819	Fixed, composition, 3 μμf., ±10%, 500 VDCW	C-34

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	CAPACITORS CONT.	
C820	Fixed, ceramic disc., .01 μf., GMV, 600 VDCW	C-20
	RECTIFIERS	
CR1	Silicon, Sarkes Tarzian Type 40K	D-5
CR2	Silicon, Sarkes Tarzian Type 40K	D-5
CR3	Silicon, Sarkes Tarzian Type 40K	D-5
CR4 thru CR100	These circuit references not assigned.	
CR101	Silicon, Sarkes Tarzian Type 40K	D-5
CR102	Silicon, Sarkes Tarzian Type 40K	D-5
CR103 thru CR500	These circuit references not assigned.	
CR501	Crystal Diode, 1N82	D-1
CR502 thru CR800	These circuit references not assigned.	
CR801	Crystal Diode, 1N82	D-1
CR802	Crystal Diode, 1N82	D-1
CR803	Crystal Diode, 1N82	D-1
CR804	Crystal Diode, 1N82	D-1
CR805	Crystal Diode, 1N23	D-4
	FUSE	
F1	3AG, 2 amp, 250 V	MP-6
	LAMP	
I1	Incandescent, #47 6-8 V	MP-5
	BNC JACKS AND TERMINATORS	
J101	Jack, receptacle, BNC Dage type 2545-1	J-10
J102 thru J400	These circuit references not assigned.	

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	BNC JACKS AND TERMINATORS CONT.	
J401	Jack, receptacle, BNC Dage type 2545-1	J-10
J402	Jack, receptacle, BNC Dage type 2545-1	J-10
J403 thru J500	These circuit references not assigned.	
J501	Terminator, cable, MX1684/U	J-9
J502	Terminator, cable, MX1684/U	J-9
J503	Jack, cable, BNC Dage type 2559-1	J-11
J504	Terminator, cable, MX1684/U	J-9
J505	Terminator, cable, MX1684/U	J-9
J506	Jack, resistor, terminator assembly	J-23
J507	Jack, resistor, terminator assembly	J-23
J508 thru J700	These circuit references not assigned.	
J701	Jack, receptacle, flange mounted	J-21
J702	Jack, receptacle, flange mounted	J-21
J703	Jack, cable, BNC Dage type 2559-1	J-11
J704 thru J800	These circuit references not assigned.	
J801	Jack, receptacle, (Part of 920 MC lo-pass filter)	
J802	Jack, receptacle, (Part of 400 MC lo-pass filter)	
J803	Jack, receptacle, (Part of S-802)	
J804	Jack, receptacle, (Part of S-802)	
J805	Jack, receptacle, (Part of S-802)	
J806	Jack, receptacle, flange mounted, UG-185/U	J-3
J807	Jack, receptacle, right angle, flange mounted, UG-535/U	J-6
J808	Jack, receptacle, flange mounted, UG-185/U	J-3

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	COIL	
L401	Adjustable, 10 mh.	L-23
L402 thru L800	These circuit references not assigned.	
L801	Fixed, .3 uh.	L-104
L802	Fixed, 2.2 uh.	L-101
L803	Fixed, 2.2 uh.	L-101
L804	Fixed, 2.2 uh.	L-100
L805	.6 uh. coil wound on 22Ω, 1/2W, 5% resistor	L-29
L806	Fixed, .3 uh.	L-104
L807	.6 uh. coil wound on 22Ω, 1/2W, 5% resistor	L-29
L808	Fixed, 2.2 uh.	L-101
L809	Fixed, 2.2 uh.	L-101
L810	Fixed, 2.2 uh.	L-100
L811	Coupling, Inductance Loop	
L812	Tuning Line, Inductance Loop	
L813	Tuning Line, Inductance Loop	
	BNC PLUGS	
P506	Cable, UG-88/U	J-1
P507	Cable, UG-88/U	J-1
P508 thru P700	These circuit references not assigned.	
P701	Cable, UG-88/U	J-1
P702	Calbe, UG-88/U	J-1
P703 thru P800	These circuit references not assigned.	
P801	Cable, UG-88/U	J-1

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	BNC PLUGS CONT.	
P802	Cable, UG-88/U	J-1
P803	Cable, UG-88/U	J-1
P804	Cable, UG-88/U	J-1
P805	Cable, UG-88/U	J-1
P806	Cable, UG-88/U	J-1
P807	Cable, UG-88/U	J-1
P808	Cable, UG-88/U	J-1
	RESISTORS	
R1	Variable, composition, 50KΩ, 1/4W	R-725
R2	This circuit reference not assigned.	
R3	Fixed, wirewound, 10KΩ, ±10%, 5W	R-404
R4	Fixed, composition, 4.7Ω, ±10%, 1W	R-206
R5	Fixed, composition, 4.7KΩ, ±10%, 2W	R-306
R6	Fixed, composition, 1KΩ, ±10%, 1W	R-208
R7	Fixed, composition, 4.7Ω, ±10%, 1W	R-206
R8	Fixed, composition, 47KΩ, ±10%, 1/2W	R-27
R9	Fixed, composition, 47KΩ, ±10%, 2W	R-305
R10	Fixed, composition, 100KΩ, ±10%, 2W	R-303
R11	Fixed, composition, 1MΩ, ±10%, 1/2W	R-31
R12	Fixed, composition, 22Ω, ±10%, 1/2W	R-11
R13	Fixed, composition, 27KΩ, ±10%, 2W	R-304
R14	Fixed, composition, 150K, ±10%, 2W	Unassigned.
R15	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R16	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R17	Fixed, composition, 220KΩ, ±10%, 1/2W	R-44

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	RESISTORS CONT.	
R18	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R19	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R20	Fixed, composition, 220KΩ, ±10%, 1/2W	R-44
R21	Fixed, composition, 220KΩ, ±10%, 1/2W	R-44
R22	Fixed, composition, 220KΩ, ±10%, 1/2W	R-44
R23	Fixed, composition, 220KΩ, ±10%, 1/2W	R-44
R24 thru R100	These circuit references not assigned.	
R101	Variable, wirewound, 25Ω, ±10%, 2W	R-713
R102	Variable, wirewound, 25Ω, ±10%, 2W	R-713
R103	Variable, wirewound, 25Ω, ±10%, 2W	R-713
R104	Variable, composition, 100KΩ, 1/4W	R-732
R105	Variable, composition, 200KΩ, 1/4W	R-724
R106	Variable, composition, 200KΩ, 1/4W	R-724
R107	Variable, composition, 100KΩ, .3W (Ganged to R801A, R801B)	R-735
R108	Fixed, wirewound, 7.5Ω, 5W, ±10%	R-403
R109	Fixed, composition, 15Ω, ±10%, 2W	R-311
R110	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R111	Fixed, composition, 1MΩ, ±10%, 1/2W	R-31
R112	Fixed, composition, 10MΩ, ±10%, 1/2W	R-47
R113	Variable, composition, 2MΩ, 1/4W	R-729
R114	Fixed, composition, 390KΩ, ±10%, 1/2W	R-72
R115	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R116	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R117	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R118	Fixed, composition, 10MΩ, ±10%, 1/2W	R-47

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	RESISTORS CONT.	
R119	Fixed, composition, 680KΩ, ±10%, 1/2W	R-30
R120	Fixed, composition, 2.7MΩ, ±10%, 1/2W	R-41
R121	This circuit reference not assigned.	
R122	Fixed, composition, 5.6KΩ, ±10%, 1/2W	R-22
R123	Fixed, composition, 220KΩ, %10%, 1/2W	R-44
R124	Fixed, composition, 390KΩ, ±10%, 1/2W	R-72
R125	Fixed, composition, 33Ω, ±10%, 1/2W	R-12
R126	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R127	Fixed, composition, 27KΩ, ±10%, 1/2W	R-25
R128 thru R200	These circuit references not assigned.	
R201	Variable, composition, 500KΩ	R-734
R202	Variable, composition, 1MΩ, 1/4W	R-728
R203	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R204	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R205	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R206	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R207	Fixed, composition, 39KΩ, ±10%, 1/2W	R-26
R208 thru R300	These circuit references not assigned.	
R301	Variable, composition, 200KΩ	R-707
R302	Variable, composition, 50KΩ, 1/4W	R-725
R303	Variable, composition, 50KΩ, 1/4W	R-725
R304	Variable, composition, 50KΩ, 1/4W	R-725
R304	Fixed, composition, 560KΩ, ±10%, 1/2W	R-29
R305	Variable, composition, 50KΩ, 1/4W	R-725
R306	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R307	Fixed, composition, 1MΩ, ±10%, 1/2W	R-31

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	RESISTORS CONT.	
R308	This circuit reference not assigned.	
R309	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R310	Fixed, composition, 39KΩ, ±10%, 1/2W	R-26
R311	Fixed, composition, 100KΩ, ±10%, 1/2W	R-28
R312	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R313	Fixed, composition, 1MΩ, ±10%, 1/2W	R-31
R314	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R315	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R316	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R317	Fixed, composition, 47KΩ, ±10%, 1/2W	R-27
R318	Fixed, composition, 330K, ±10%, 1/2W	R-94
R319 thru R400	These circuit references not assigned.	
R401	Fixed, composition, 47KΩ, ±10%, 1/2W	R-27
R402	Fixed, composition, 100KΩ, ±10%, 1/2W	R-28
R403	Fixed, composition, 4.7KΩ, ±10%, 1/2W	R-21
R404	Fixed, composition, 47KΩ, ±10%,1/2 W	R-27
R405	Fixed, composition, 22KΩ, ±10%, 1/2W	R-24
R406	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R407	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R408	Variable, composition, 100KΩ, 1/2W	R-705
R409	Fixed, composition, 100KΩ, ±10%, 1/2W	R-28
R410	Fixed, composition, 4.7KΩ, ±10%,1/2W	R-21
R411	Variable, composition, 100KΩ, 1/2W	R-705
R412	Fixed, composition, 47KΩ, ±10%, 1/2W	R-27
R413	Fixed, composition, 100Ω, ±10%, 1/2W	R-15

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	RESISTORS CONT.	
R414	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R415	Fixed, composition, 1KΩ, ±10%, 1/2W	R-18
R416	This circuit reference not assigned.	
R417	Fixed, composition, 1KΩ, ±10%, 1/2W	R-18
R418	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R419	Fixed, composition, 100Ω, ±10%, 1/2W	R-15
R420	Fixed, composition, 1KΩ, ±10%, 1/2W	R-18
R421	Fixed, composition, 1KΩ, ±10%, 1/2W	R-18
R422	Fixed, composition, 4.7KΩ, ±10%, 1/2W	R-21
R423	Variable, composition, 100KΩ, 1/2W	R-705
R424	Fixed, composition, 100KΩ, ±10%, 1/2W	R-28
R425	Fixed, composition, 5.6KΩ, ±10%, 1/2W	R-22
R426	This circuit reference not assigned.	
R427	Fixed, composition, 10KΩ, ±10%, 1/2W	R-23
R428 thru R500	These circuit references not assigned.	
R501	Fixed, composition, 220Ω, ±10%, 1/2W	R-39
R502	Fixed, composition, 470Ω, ±10%, 1/2W	R-42
R503	Fixed, composition, 56Ω, ±5%, 1/2W	R-53
R504	Fixed, composition, 56Ω, ±5%, 1/2W	R-53
R505	Fixed, composition, 120Ω, ±10%, 1/2W	R-16
R506	Fixed, composition, 120Ω, ±10%, 1/2W	R-16
R507	Fixed, composition, 56Ω, ±5%, 1/2W (Part of J506)	R-53
R508	Fixed, composition, 56Ω, ±5%, 1/2W (Part of J507)	R-53

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	RESISTORS CONT.	
R509 thru R800	These circuit references not assigned.	
R801A, R801B	Dual, variable, wirewound, 6Ω, 2W., 6Ω, 2W (Ganged with R107)	R-735
R803	Fixed, composition, 120Ω, ±10%, 1/2W	R-16
R804	Fixed, composition, 220Ω, ±10%, 2W	R-39
R805	Fixed, composition, 180Ω, ±10%, 1/2W	R-52
R806	Fixed, composition, 4700Ω, ±10%, 1/2W	R-21
R807	Fixed, composition, 120Ω, ±10%, 1/2W	R-16
R808	Fixed, composition, 4700Ω, ±10%, 1/2W	R-21
R809	Fixed, composition, 120Ω, ±10%, 1/2W	R-16
R810	Fixed, composition, 330Ω, ±10%, 1/2W	R-17
R811*	Fixed, composition, 300Ω, ±5%, 1/2W	R-77
R812*	Fixed, composition, 300Ω, ±5%, 1/2W	R-77
R813*	Fixed, composition, 18Ω, ±10%, 1/2W	R-78
	SWITCHES	
S1	Toggle, SPST	SW-10
S2 thru S500	These circuit references not assigned.	
S501 thru S508	Toggle, SPST	SW-10
S509 thru S800	These circuit references not assigned.	
S801	Circuit	SW-107G
S802	Coaxial Band	SW-12
	TRANSFORMER	
T1	Power	T-9A

*These are selected values. See schematic

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	TUBES	
V1	Electronic: 5651 (Voltage Regulator)	VT-17
V2	Electronic: 6AU6	VT-5
V3	Electronic: EL84/6BQ5	VT-16
V4	Electronic: EL84/6BQ5	VT-16
V5 thru V100	These circuit references not assigned.	
V101	Electronic: 12AX7	VT-13
V102	Electronic: 12AX7	VT-13
V103 thru V200	These circuit references not assigned.	
V201	Electronic: 12AX7	VT-13
V202 thru V300	These circuit references not assigned.	
V301	Electronic: 6AU6 (6EU6 in some units)	VT-5
V302	Electronic: 12AX7	VT-13
V303	Electronic: 6AU6	VT-5
V304	Electronic: EL84/6BQ5	VT-16
V305 thru V400	These circuit references not assigned.	
V401	Electronic: 12AX7	VT-13
V402	Electronic: 12AX7	VT-13
V403	Electronic: 12AX7	VT-13
V404	Electronic: 12AX7	VT-13
V405 thru V800	These circuit references not assigned.	
V801	Electronic: 6AF4	VT-4
V802	Electronic: 6AF4	VT-4

PARTS LIST
(Continued)

CIRCUIT REF.	DESCRIPTION	PART NO.
	MISCELLANEOUS	
Z501	Socket, 6 pin	S-11
Z502	Socket, 6 pin	S-11
Z503	Socket, 6 pin	S-11
Z504	Socket, 6 pin	S-11
Z505	Socket, 6 pin	S-11
Z506	Socket, 6 pin	S-11
Z507	Socket, 6 pin	S-11
Z508	Socket, 6 pin	S-11
Z701	Attenuator, turret	TA-50
Z801	Wobbulator	Not Assigned
Z802	Wobbulator	Not Assigned
	Bushing, AC line cord strain relief	H-23
	Bushing, tuning shaft ground	SM-11
	Cord, AC line	W-6
	Filter, low pass 920 MC	Not Assigned
	Filter, low pass 400 MC	Not Assigned
	Fuseholder	MP-31
	Knob, Bar: Attenuator	K-5
	Knob, round 2"	K-1
	Knob, round 5/8"	K-4
	Nib, tuning	SM-2
	Socket, Diode	S-9
	Socket, 7 pin mica filled	S-7
	Socket, 7 pin printed circuit	S-4
	Socket, 9 pin printed circuit	S-5
	Socket Assembly, Pilot Light	MP-3
	Tuning Line Assembly	Not Assigned

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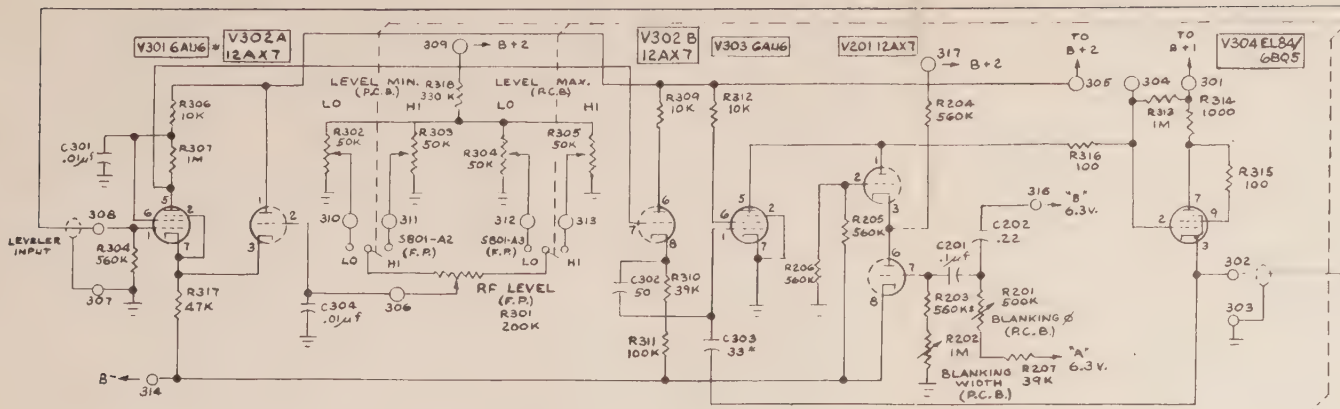
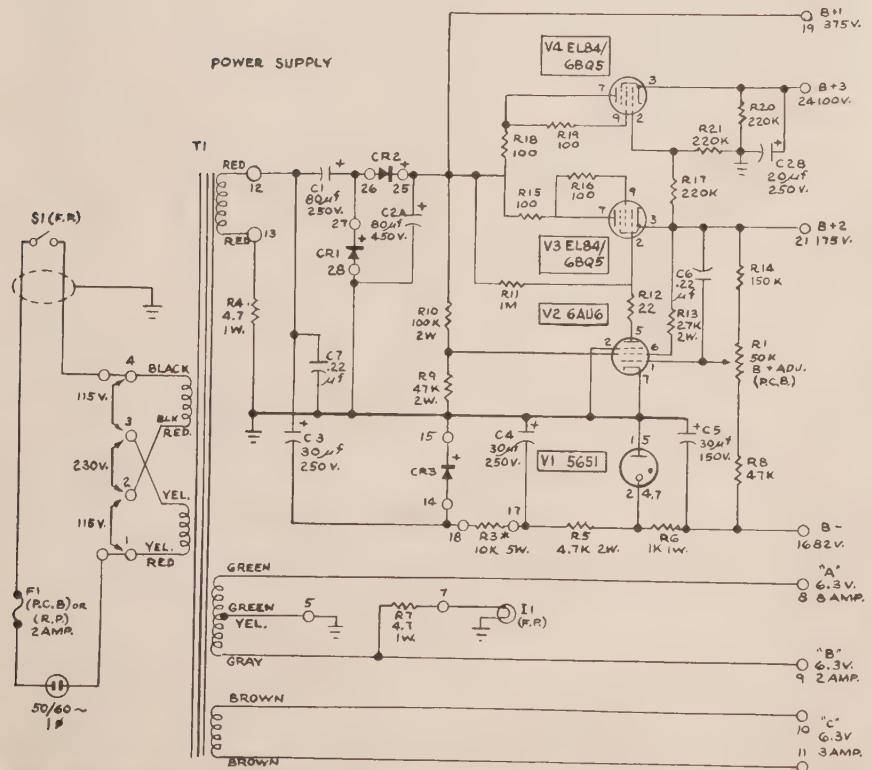
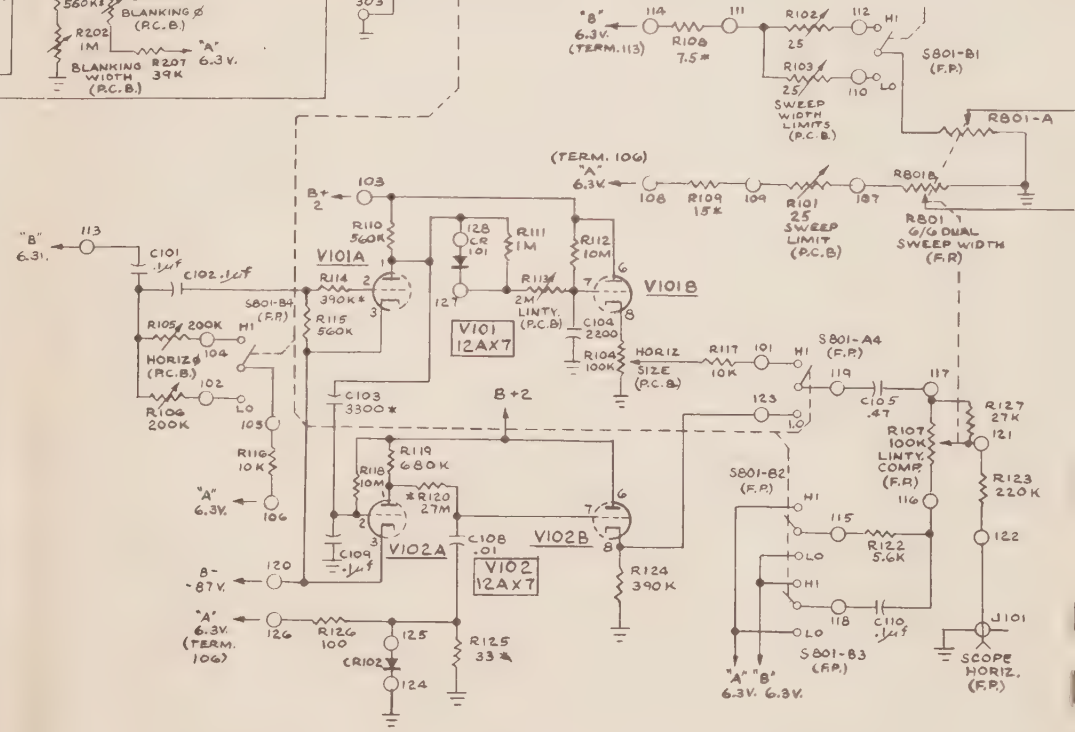
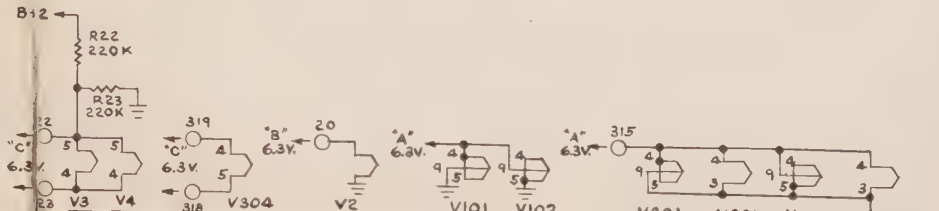


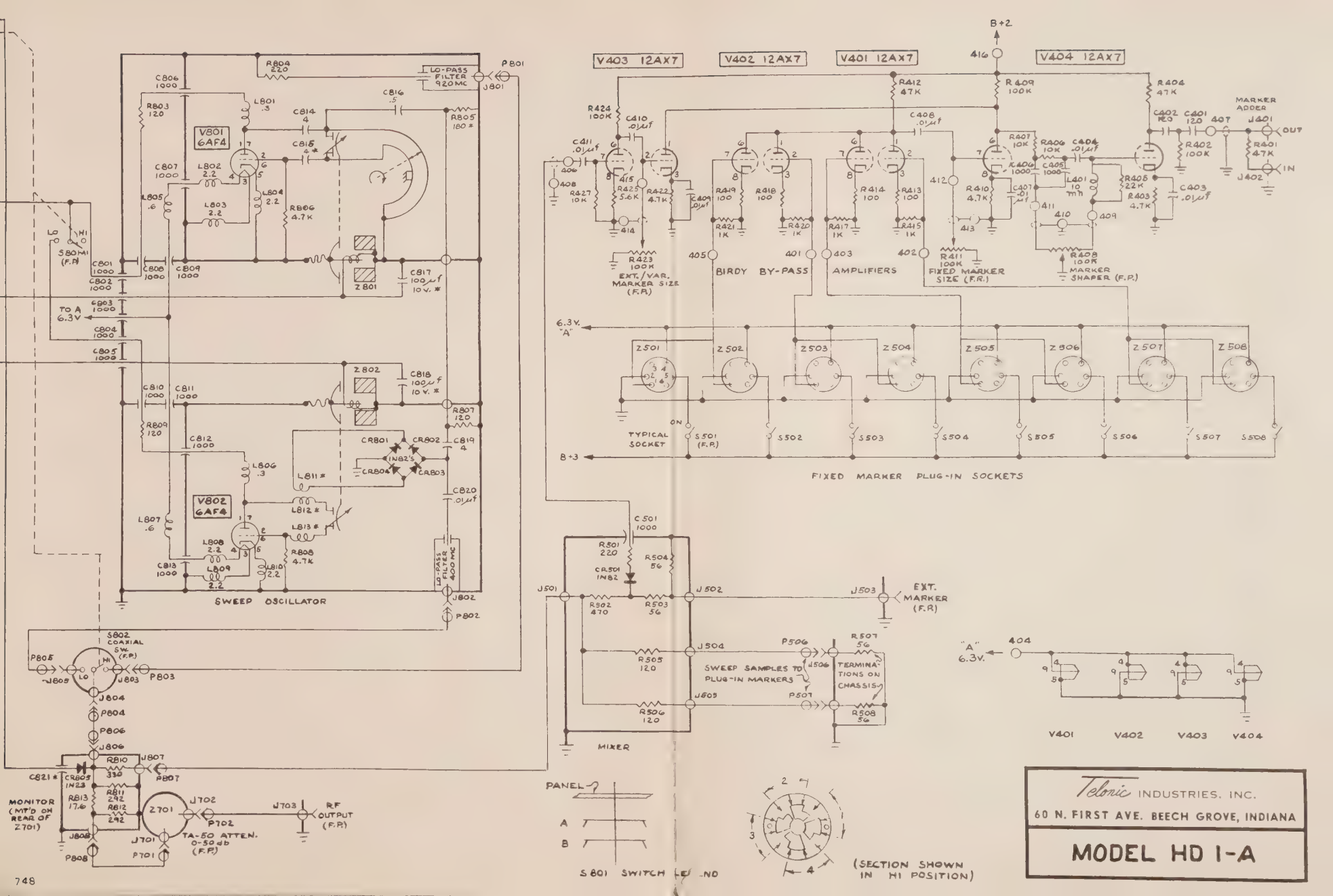
LEVELER & BLANKING





LINEARITY & SWEEP DRIVE





Telonic INDUSTRIES, INC.
60 N. FIRST AVE. BEECH GROVE, INDIANA

MODEL HD 1-A

SWEEP GENERATORS

Telonic®

CATALOG 8-C

for precise measurement of frequency response . . .

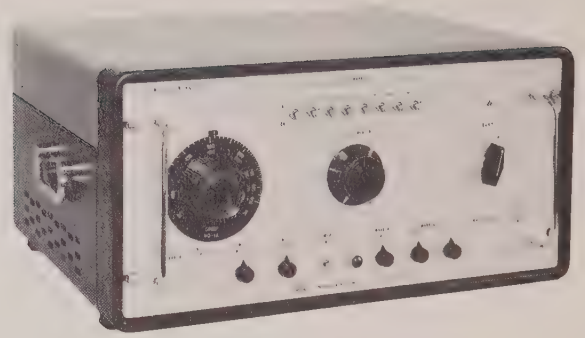
. in the laboratory

. . . on the production line

- *Sweep Generators*
- *Marker Equipment*
- *RF Attenuators*
- *RF Detectors*
- *RF Filters*

Telonic INDUSTRIES, INC. BEECH GROVE, INDIANA

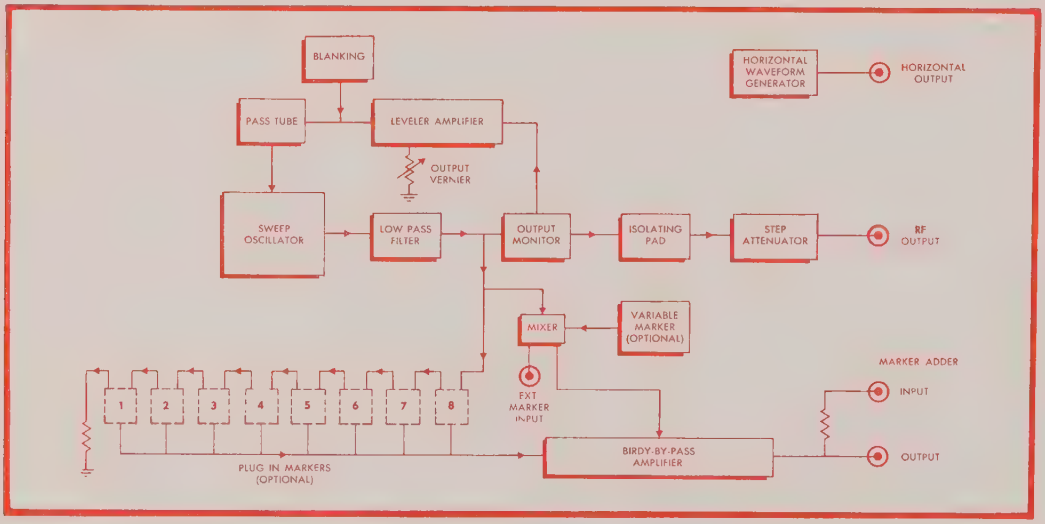
Telonic SWEEP GENERATORS



The ultimate check on RF circuit quality is frequency response. Telonic Sweep Generators permit accurate, rapid measurements of frequency response under both laboratory and production-line conditions.

A Telonic Sweep Generator scans the entire frequency range in a 60th of a second, replacing the tedious point-to-point testing normally required. At the same time, the amplitude of the swept signal is precisely controlled to produce a constant voltage input to the circuit under test.

The circuit output is normally demodulated and presented as a continuous oscilloscope trace. Precision attenuators allow quantitative measurements of the results. Internal and external markers provide automatic frequency calibration. Telonic Sweep Generators may be used to perform rapid frequency-response tests on filters, mixers, amplifiers, and a wide variety of other RF circuits.



BLOCK DIAGRAM FOR TYPICAL TELONIC SWEEP GENERATOR

ACCURATE MEASUREMENTS

The heart of every Telonic Sweep Generator is a vacuum-tube oscillator. The frequency of this oscillator is swept through the desired range by a modulator consisting of either a saturated ferrite core or a precision vibrating capacitor. A sawtooth voltage is provided for connection to the horizontal input of the oscilloscope. This waveform is in phase with the swept signal and provides the "X" axis value of the instantaneous amplitude versus frequency graph appearing on the oscilloscope. The oscillator is cut-off during the return sweep providing a flat base line on the oscilloscope for quantitative measurements.

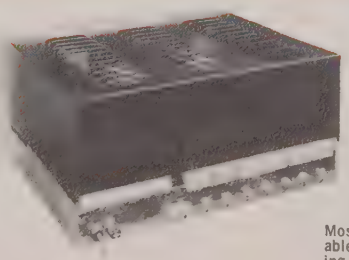
In point-to-point frequency response determinations, the power of a standard type signal generator must be adjusted each time a new frequency is selected. A Telonic Sweep Generator makes this adjustment automatically and continuously. An electronic regulator maintains the power output of the oscillator circuit at a constant level.

Accurate toggle switch or turret attenuators reduce the power input to the circuit under test by precisely known amounts. These attenuators have been especially designed for flat frequency response across the range being measured. Frequency markers are superimposed on the signal trace (see last page) *after* it has passed through the circuit under test and has been detected, preventing any distortion in the amplitude measurement.

PHYSICAL DESCRIPTION

Panel — ⅛" x 8¾" x 19"
Chassis — 2" x 14½" x 17"

Bench models are enclosed in a hinged top grey and black satin cabinet.



For rack mounting, bench models are enclosed by dust covers and finished in flat black enamel.

Most bench models are also available in portable cabinets. Provisions are included for adding up to eight plug-in markers.

GENERAL SPECIFICATIONS (Generally applicable to Telonic Sweep Generators)

Flatness.....±5% over maximum sweep width
Zero Base Line.....Oscillator off during return sweep
Sweep Rate.....Line frequency (50-60 cps)
Horizontal Sweep.....Approximately 15 volts
Vernier Attenuation.....0-10 db.

Power.....115 v. 50/60 cycle, approx. 120 watts
Display Linearity.....Better than 1.2:1
Radiation.....Less than 10 microvolts
Source VSWR.....Below 1.3:1
Markers.....Birdy-By-Pass Marker System

Variable Markers.....Available on HD-3, 4 and 7, LD, LR, SD & ED Models

Model	Center Frequency	Sweep Width	Range	Attenuation (db) (T) Turret (S) Toggle Switch	Output (into 50 ohms)	Remarks	Bulletin Number
HD-1A	.5-400 mc 390-900 mc	200kc-200 mc .06-10%	.5-910 mc	T-0, 10, 20, 30, 40, 50	.75V, p to p 1.5V, p to p	Lo band heterodyne Hi band fundamental	T-209
HD-3	.5-200 mc	200kc-200 mc	.5-300 mc	T-0, 10, 20, 30, 40, 50	.75V, p to p	Heterodyne type—wide sweep width and tunable center frequencies	T-210
HD-4	10kc-10 mc	25kc-10 mc	10kc-15 mc	S-20, 20, 20, 10, 6, 3	1V, p to p	Video sweep—wide or narrow	T-213
HD-7	100kc-75 mc	100kc-50 mc	100kc-100 mc	S-20, 20, 20, 10, 6, 3	1V, p to p	Video and IF frequencies Higher video and IF frequencies	
LD-3	4-15 mc	.05-40% of CF	3.5-17.5 mc	S-20, 20, 20, 20, 20, 10, 5, 3, 2, 1	1uV-1V, RMS	Electronically swept • Fundamental frequency type • Wide range of output levels • Exceptionally stable, flat and free from spurious content	T-214
LD-4	10-35 mc	.05-40% of CF	9-40 mc				
LD-5	20-75 mc	.05-40% of CF	16-90 mc				
LD-6	50-125 mc	.05-30% of CF	45-140 mc				
LR Series with plug-in sweeper heads				S-20, 20, 20, 20, 20, 10, 5, 3, 2, 1	1uV-1V, RMS	Similar to LD Models, but includes variable sweep rate of .01 to 100 cps and other features. For testing narrow band devices, crystal filters, etc.	T-215
PLR-3	4-15 mc	.05-40% of CF	3.4-17.5 mc			Plug-in Sweep Oscillator Heads for use with the LR series Variable Rate Sweep Generators	
PLR-4	10-35 mc	.05-40% of CF	9-40 mc				
PLR-5	20-75 mc	.05-40% of CF	16-90 mc				
PLR-6	50-125 mc	.05-30% of CF	45-140 mc				
SD-2	215-450 mc	.03-15% of CF	200-460 mc	T-0, 10, 20, 30, 40, 50	1V, RMS	Capacitive sweep Center frequency tuning Exceptionally flat VHF-UHF-low microwave applications	T-207
SD-3	440-920 mc	.06-10% of CF	425-930 mc	T-0, 10, 20, 30, 40, 50	.75V, RMS		
SD-4	930-1250 mc	.1-50 mc	900-1260 mc	T-0, 10, 20, 30, 40, 50	.75V, RMS		
SD-200		180 mc	260-440 mc	T-0, 10, 20, 30, 40, 50	1V, RMS	Capacitive sweep Fixed tuned Exceptionally wide, flat sweep Wide band applications UHF and microwave	
SD-201		175 mc	325-500 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-202		250 mc	500-750 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-203		300 mc	650-950 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-204		400 mc	800-1200 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-205		350 mc	900-1250 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
SD-206		200 mc	1200-1400 mc	T-0, 10, 20, 30, 40, 50	1V, RMS		
ED-1A	1000-1700 mc	.02-6% of CF	975-1750 mc	Vernier 0-10 db	.3V, RMS	Output is the result of 2nd harmonic generation and filtering—and thus these ranges are obtained from the highly reliable SD type of oscillator	T-216
ED-4A	1350-2400 mc	.02-6% of CF	1350-2450 mc				
PD-1	5-50 mc	0-20%	4.2-53 mc	T-0 to 59 db in 1 db steps	4 watts Sweep & Mod. CW, 2 watts Unmodulated CW	HI POWER SWEEP & CW Generator excellent for FILTER and RF transmission line and antenna testing. Functions include Sweep; Mod. sweep; CW & Mod. CW; Internal 1000 cps modulation	T-217
PD-2	20-100 mc	0-20%	17-105 mc				
PD-3	100-250 mc	0-20%	85-260 mc				
PD-4	250-500 mc	0-20%	210-520 mc				
PD-5	300-600 mc	0-20%	250-625 mc				
PD-6	500-1000 mc	0-15%	450-1010 mc				

T-206A

SSX-2 Series — Available in ranges from 1 mc to over 100 mc. Similar to LD models but includes: CW, mod. CW, pulsed CW, variable marker and other features. Ideal for IF amplifier testing.

BULLETIN No. T-206A

T-208

302 and 303 Test Sets — Instruments now being used for testing missile and radar IF systems — engineering, production and included as ground support equipment.

BULLETIN No. T-208

T-203B

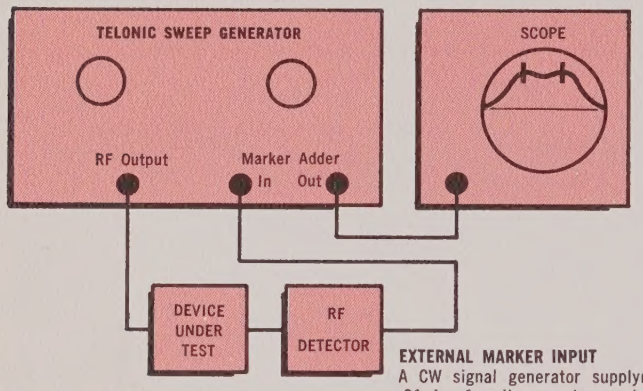
VHF and UHF TV Production Sweep Generators — Telonic Sweep Generators are used universally by almost every television manufacturer in the United States and overseas. Numerous models with unique features and special accessories are available.

BULLETIN No. T-203B

BIRDY-BY-PASS MARKER SYSTEM

In this system, beat or birdy pips are produced by mixing a sample of the sweep oscillator signal with the marker output. The "birdies" are fed through an amplifier and are added to the demodulated sweep signal before it is connected to the scope vertical amplifier. The markers completely bypass the device under test.

Since the markers are produced directly, no frequency error can occur other than in the marker oscillator itself. In addition to accuracy it features — stability, versatility and simplicity.



EXTERNAL MARKER INPUT
A CW signal generator supplying .01 to .1 volts may be used to produce a variable marker.

Eight plug-in sockets are included on the chassis of the HD, LD, SD, LR and ED Sweep Generators. Eight ON/OFF switches are also mounted on the front panel. This permits mounting up to eight of the "C" and "CH" type markers, up to four "CDH" type, or a combination of the plug-in types.

The "C" unit makes use of crystals up to 60 mc and generates a *single* marker by use of frequency selective circuits that combine the approximate harmonic with the swept signal sample in a diode mixer. Single markers can be produced to as high as 1250 mc.

PLUG-IN MARKERS

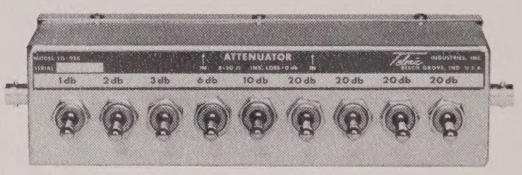
The selective circuits of the "C" unit are omitted in the "CH" units; thus a marker is produced at each harmonic of the crystal. The amplitude of the harmonics decrease therefore limiting the usefullness of the "CH" units to between the 10th or 15th harmonic.

The "CDH" circuit includes two dual triodes to greatly extend the range of harmonics. These units maintain a relatively constant level to as high as the 200th harmonic. Crystal frequencies of from 0.5 to 10 mc are normally used. Since an untuned type of oscillator circuit is used, frequency depends solely upon the crystal used.

BULLETIN No. T-218

RF ATTENUATORS

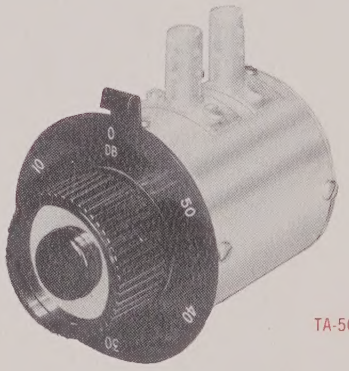
Telonic RF Attenuators are available in two forms: toggle switch and turret. The toggle switch type is recommended in the frequency range, 0-250 mc. Turret attenuators may be used to 1,250 mc. Connectors are BNC type.



TG-950 STEP ATTENUATOR

Toggle Switch Attenuators are supplied in standard models containing 6 or 9 steps, with 1.0 to 20 db of attenuation per step. Resistor accuracies are 1% and impedances of 50 or 75 ohms may be specified. A six-step unit measures 1⅞ x 1⅞ x 5⅛.

BULLETIN No. T-201B



TA-50 TURRET ATTENUATOR

THE TELONIC MODEL TA-50 TURRET ATTENUATOR is a highly accurate, six-position unit providing 0, 10, 20, 30, 40 and 50 db attenuation of RF signals from DC to 1250 mc.
Other Telonic Turret Attenuators are available that provide accurate attenuation in the 0-10 and 0-59 db ranges in 1 db steps, and tandem units of these configurations to operate two separate circuits simultaneously.

BULLETINS No. T-212A and T-227

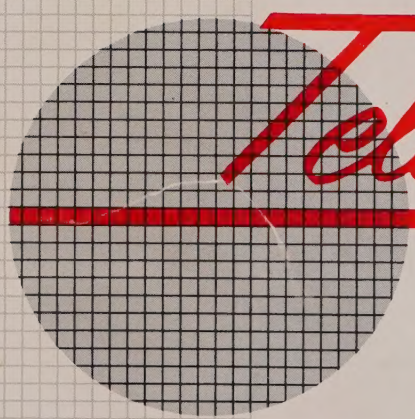
XD-3A RF DETECTOR

Telonic RF Detectors are used whenever the circuit under test lacks "built-in" demodulation or "look" points. The Telonic RF Detectors are available in a wide range of impedance values. The complete unit includes a termination resistance, an easily replaced crystal diode, and a low pass filter to remove RF from the DC output.

Model XD-3A is a 1-1250 mc detector generally recommended for use with the HD-1, HD-3 and SD Telonic Sweep Generators. Model XD-8 is recommended for use with the HD-4, HD-7 and LD Telonic Sweep Generators, and in all applications involving the frequency range 1-250 mc. Model XD-36 is recommended for the ED Series Sweep Generator and is designed for the range of 1000-2500 mc.

BULLETIN No. T-204A

Telonic INDUSTRIES, INC.
BEECH GROVE, INDIANA



Telonic

INDUSTRIES INC.

BEECH GROVE, INDIANA